

Hip prosthesis comprising a shaft
to be inserted into the femur

For anchoring a prosthesis shaft in the femur, the
5 conditions in the metaphyseal region are different than
those in the diaphyseal region. In the metaphyseal
region, i.e. principally in the region above the lesser
trochanter, the wide bone space is filled with spongy
bone substance in which an artificial receiving channel
10 has to be created to receive a prosthesis shaft. Since
the spongy bone substance is soft, the possibilities of
force transmission in this region are limited. Below
the lesser trochanter, the narrower medullary space is
delimited by thick cortical bone, which affords much
15 better conditions for force transmission. Prosthesis
shafts have therefore been developed that are
especially suitable for anchoring and wedging in this
diaphyseal region of the bone (Schneider: Die
Totalprothese der Hüfte [The total hip prosthesis],
20 page 214 et seq.). Their reliable anchoring in the
diaphyseal region of the bone has the effect that the
metaphyseal region of the bone is not loaded. If bone
substance is not subjected to loading, it is gradually
broken down. This is undesirable.

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In prostheses which are primarily to be anchored in the
metaphyseal region of the bone, it is known (EP-B-
761183; EP-A-780106; EP-A-1070490; EP-B-159462; EP-B-
821923; EP-B-112435; DE-C-4428099) to improve the
30 anchoring in the metaphyseal region by means of fins
and edges projecting from the ventral and dorsal
surfaces of the main body of the prosthesis. These fins
require a considerable extent in the lateromedial
direction if they are intended for anchoring in bone
35 cement or in a hollow that has been reamed out with the
same shape (EP-A-780106; EP-A-1070490; DE-C-4428099).
In cementless implantation, however, a particularly
stable postoperative fit of the prosthesis in the bone
is achieved if fins are used which, in cementless

implantation, cut into the bone substance and compress it (EP-B-761183). The hollow space formed in advance in the bone prior to insertion of the prosthesis shaft is then limited to the volume of the main body of the shaft. To ensure that the fins do not burst the bone when the shaft is driven in, they are made narrow and have inclined medial and lateral flanks (EP-B-159462; EP-B-821923; EP-B-761183). This limits their ability to transmit forces.

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The invention relates to the type of prosthesis in which anchoring is sought primarily in the diaphyseal region of the bone. The object of the invention is to counteract the degradation of bone caused by inadequate loading in the metaphyseal region.

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The solution according to the invention is that, in accordance with claim 1, the metaphyseal region is provided with additional force-transmitting means formed by fins. These fins have a particular shape with a steep flank facing in the medial direction. The fin surface facing to the front or rear is accordingly made wider than in the case of the known narrow fins with inclined medial and lateral flanks. However, to ensure that no force arises which could burst the bone when the shaft is being driven into said bone, it is further provided that the fin decreases in height in the lateral direction from the edge delimiting the medial flank. The customary, laterally oriented flank of the fins thus disappears or is reduced to a relatively low height which is at most half the height of the medial flank. This is acceptable because the forces to be transmitted in the lateral direction by the fin are less than the medially directed forces.

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The feature to the effect that the medial flank is steep signifies that it forms an almost right angle with the mediolateral plane of the shaft. It should preferably not deviate from this by more than 25°, more

preferably by not more than 15° .

At least over part of its length, the medial flank deviates from the longitudinal direction of the shaft and at the top is inclined toward the femoral neck. This shape has the advantage that when the prosthesis is inserted, if the direction of insertion coincides with the longitudinal direction of the prosthesis, the medial flank of the fin, acting like a wedge, compacts the spongy bone substance located in front of it in the insertion direction so that this is able to transmit greater forces. This effect is primarily produced if the angle enclosed by this flank of the fin and the longitudinal direction of the shaft is between 5° and 15° , preferably about 10° .

According to the invention, a corresponding compression on the anterior and posterior faces of the fins can be achieved by the fact that the height of the fins above the respective surface of the main body of the shaft increases from the bottom upward. The fin is thus wedge-shaped in two directions, namely in the first instance toward the medial face and in the second instance toward the anterior or posterior face. The height of the fin can gradually decrease in the lateral direction, i.e. at the side directed away from the steep flank.

The compression of the spongy bone substance by the fins assumes that bone substance was previously present at the place where the fins are located after implantation. If, before insertion of the prosthesis, a channel for receiving the prosthesis shaft is artificially created in the metaphyseal region of the bone, this channel should simply correspond to the cross-sectional shape of the main body of the prosthesis shaft and should therefore not have any bulged-out areas for subsequently receiving the fins. If a rasp is used to form this receiving channel, its

shape ought therefore to correspond only to the main body of the shaft, without having means for removing material in the fin area. Alternatively, it is also possible to equip the rasp with fins which correspond to the fins of the prosthesis shaft and are designed for compression of the bone substance without removing material. The above-described compression of the bone substance in the force transmission region of the fins thus comes about through the rasp itself or is prepared partially by the latter.

The invention is explained in more detail below with reference to the drawing which depicts an advantageous illustrative embodiment and in which:

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Fig. 1 shows a front view;
Fig. 2 shows a medial view;
Fig. 3 shows a top view; and
Figs 4 to 6 show cross sections through the shaft at the corresponding heights thereof.

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The prosthesis is composed of a shaft 1, a neck 2 and a cone 3 for attachment of an articulation head 4 whose circumference is indicated by a dot-and-dash line. The shaft is made up of a proximal portion 6 and a distal portion 7. The proximal portion is elongate in cross section in the LM direction, as is shown in Figures 4 and 5. It is provided with a pair of fins 8 for transmitting force to the spongy bone substance surrounding the shaft in the epiphyseal region of the femur. The shaft 1 can be seen as a straight shaft. This means that it is of straight configuration and, accordingly, has to be driven into the femur in its longitudinal direction and in the longitudinal direction of the femoral diaphysis.

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The transition 9 between the proximal portion and the distal portion of the shaft is arranged so that, in the implanted state, it comes to lie approximately at the

lesser trochanter, preferably slightly below the latter, and the distal shaft portion 7 accordingly lies in a region of the medullary canal in which the latter is delimited by thick cortical bone. The transition
5 does not need to be specially marked on the prosthesis. It is determined by the fact that it lies at the point where, in the implanted state, the lesser trochanter or preferably the lower edge of the latter is assumed to be located. It lies generally about 7 to 9 cm deeper
10 than the center point 5 of the articulation head 4, measured according to arrow 10 in the shaft direction.

~~The distal shaft portion is designed such that it is~~
suitable for anchoring in the diaphyseal region of the
15 femur. To obtain a firm fit, its shaft core is weakly conical and equipped with longitudinal ribs. In this way, the bone substance located in the space between the surface of the shaft core 15 and the cortical margin of the medullary space, is compressed, and, in
20 the process, is held firmly by the ribs. The distal portion can also be configured in another way suitable for primary anchoring of the shaft in the diaphysis of the bone.

25 The fins 8 rise from the anterior and posterior surfaces 21 of the main body 22 of the shaft. They have a steep flank 23 oriented in the medial direction, and an anterior or posterior surface portion 24 delimited laterally by an edge 25. The surface 24 drops off
30 toward the surface 21 as its distance from the flank 23 increases, so that the fin acquires an approximately triangular or trapezoidal cross-sectional shape, as can be seen in Figures 3 and 4. Its height above the surface 21 of the main body 22 is at least twice as
35 great at the medial edge 23 as it is at the lateral edge.

The fins 8 begin at the transition 9 between the proximal portion and the distal portion 7 of the shaft,

with a zero height and a minimal width. In the upward direction, they grow uniformly to their maximum height and width, which they reach at the upper end 26. With the longitudinal axis 27 of the shaft, the flank 23
5 encloses an angle α which, in the illustrative embodiment, is approximately 8° . The height of the flank 23 at the upper end 26 of the shaft is between 2 and 4 mm, preferably about 3 mm. The height of the flank 25 is between zero and half the height of the
10 flank 23. In side view, the flank 25 coincides with the longitudinal axis 27 or extends parallel thereto or at a very small angle thereto.

The cross-sectional surface of the fins increases in a
15 wedge shape from the bottom upward in two directions, namely toward the flank 23 and toward the anterior and posterior surfaces 24. If the hollow formed for receiving the prosthesis shaft in the metaphyseal, spongy region of the femur is identical in cross
20 section to the main body 22 of the shaft, then the fins 8, when the shaft is driven in, displace the spongy substance located there and compact it. It is thus made more suitable for transmitting forces. The dropping-away of the fin from the medial edge to the lateral
25 edge has the further advantage that the space available in the metaphysis of the bone can be better utilized for a large shaft design.

The illustrative embodiment shows a linear course of
30 the fins 8. Their wedge shape, however, can also have a nonlinear course.

Although the prosthesis is intended for primary anchoring in the diaphysis, the fins 21, and the other
35 surfaces 28 of the prosthesis shaft that are oriented in the medial direction, contribute to the transmission of forces in the metaphyseal region too. The metaphysis of the bone thus participates in the transmission of force. The danger of its degeneration is thus reduced.

The long-term secure hold of the prosthesis in the bone is improved.